SUMMARY OF ATSRAC RECOMMENDATIONS TO FAA

Task 1 (Sampling Inspection of the Fleet - August 2000)

Recommendation 1: The airplane manufacturers should evaluate, using the processes outlined in Appendix C [of the Task 1 Final Report], all Significant Inspection Items for appropriate additional action, including but not limited to design changes, enhanced inspection procedures, accelerated inspection intervals, etc. Results should be validated by the applicable airplane working groups prior to transmittal to ATSRAC. OEM's should also communicate pertinent data to affected operators.

Response 1: The OEM's and representatives of participating airlines, the applicable OEM and the FAA which comprise the airplane **model working groups have completed this recommended action**. Results of the evaluation are provided in Appendix C [of the Task 1 Final Report].

The FAA has validated the OEM review of the significant findings and did not identify a finding requiring mandatory action. However, the data collected is being utilized in the development of Phase 2 ATSRAC recommendations that will lead to proposed FAA rulemaking and advisory circulars for maintenance, training and design.

Recommendation 2: Consider the content of each non-intrusive evaluation document in order to identify typical enhancements that will need to be implemented in existing maintenance programs.

Response 2: The data contained in the evaluation documents were incorporated into the Task 3, 4 and 5 reports. These reports are being utilized in the Phase 2 taskings and will be included in proposed FAA rulemaking and advisory circulars for maintenance and training.

Recommendation 3: Consider the content of ATA Specification 117, Wiring Maintenance Practices/Guidelines to enhance the awareness of wiring issues (i.e., inspection, installation, cleanliness, maintenance and repair).

Response 3: Spec 117 is utilized as source data in Phase 2 task 7.4, "Define Standard Content (SWPM) and Task 8.4, "Identify SWPM Recurrent Training." Spec 117 was also a data source for the Task 3 report on maintenance enhancements. The Spec 117 Video is included in the Task 5 recommendations for the Training Curriculum and Lesson Plans.

Recommendation 4: Identify appropriate logic to develop specific inspection tasks to permit enhancement of maintenance program documents or upgrade to MSG-3 GVI criteria. Also review appropriate intervals.

Response 4: The logic identified in Recommendation 4 is contained in the Task 3 report and is referred to as the Enhanced Zonal Analysis Procedure (EZAP). The EZAP is the basis for Phase 2 task 9.4, which is to recommend information to enable the FAA to mandate, via a proposed SFAR, the completion of an EZAP. The EZAP will be included in a proposed FAA AC in conjunction with the SFAR. The EZAP is also undergoing a voluntary prototype program with NWA, Boeing and the FAA.

Recommendation 5: Enhance standard practices by identifying recommendations that may be implemented in an individual airline foreign object damage (FOD) program to preclude debris contamination inside the aircraft during maintenance or modifications. Implement a "clean as you go" philosophy.

Response 5: The "clean as you go" philosophy was incorporated into recommendations from Phase 1 reports from tasks 3, 4, and 5. Task 3 report recommends that this philosophy needs to become a cultural change and not simply a process change. Phase 2 Tasks 7.4, 8.3, 8.4 and 9.3, among others; will utilize the Task 1, Recommendation 5 as a basis for completion. The Phase 2 recommendations will form the basis for proposed FAA rulemaking and ACs.

Additionally, OEMs have begun including notes in their service bulletins raising the attention that damage to wire bundles may occur if not protected and properly cleaned during maintenance/modifications.

Recommendation 6: Incorporate into aircraft maintenance documentation additional cautions and procedures aimed at preventing accidental damage and/or contamination of wiring installations.

Response 6: Chapter 8, Minimization of Contamination**,** of the Task 3 report is devoted to updating documentation based on Recommendation 6. This report is the main data source for the Phase 2 task, 9.3. The resulting recommendation from this task will be used as a source for proposed FAA rulemaking and AC for maintenance program enhancements.

Recommendation 7: Review the above recommendations following the completion of the intrusive wiring inspection program for possible changes and/or amendments.

Response 7: The recommendations above have been reviewed against the intrusive inspection recommendations. No changes were necessary. However, to ensure a complete utilization of the intrusive inspection recommendations all Phase 2 tasks are required to incorporate the intrusive inspection recommendations into their subsequent Phase 2 recommendations. The ATSRAC is managing this function and is expected to receive status reports at the ATSRAC meetings.

The intrusive inspection recommendations will be incorporated into FAA proposed rulemaking and ACs for maintenance, training and design via the ATSRAC Phase 2 recommendations.

Recommendation 8: Determine requirement for and implement improved reporting for wiring service history through enhanced ATA chapter organization.

Response 8: Improved wire reporting is being accomplished through addition of sub-chapter 97 to the wire reporting codes and will be included in the guidance for the new SDR rule. Improved wire reporting and analysis is also a part of the FAA's Enhanced Airworthiness Program for Airplane Systems.

Task 2 (Review of Fleet Service History - August 2000)

Recommendation 1: The airplane manufacturers evaluate, using the processes as outlined in Appendix D [of the Task 1 Final Report], all service history documents categorized as A, B, or C for appropriate additional action. Appropriate action includes, but is not limited to, raising a document to Alert status. Priority should be given to Category A documents first, then B and C respectively. OEMs should also communicate pertinent data to affected operators.

Response 1: OEMs accomplished this review for all categories of service documents. The results, as validated by representatives of participating airlines, the applicable OEM and the FAA which comprise the airplane model working groups, are provided in Appendix D [of the Task 1 Final Report] to this document.

The FAA determined the need to mandate 24 of the 69 service bulletins that were identified as candidates for alert status. Approximately 21 of these service bulletins will be mandated in a final rule airworthiness directive (AD) by October 31, 2001. The remaining three ADs will follow shortly as the corresponding OEM service bulletins required revisions.

The affected OEM's have identified to their operators the 69 service bulletins that ATSRAC recommended needed further review for possible alert status. This raises the awareness to operators that their wiring installations can be further enhanced via installation of the identified service bulletins.

Recommendation 2: The FAA review the eight airworthiness directives contained in Appendix H [of the Task 1 Final Report] to this report for consideration of mandating termination of the repetitive actions.

Response 2: X of the 8 Repetitive Inspection ADs will be issued as ADs with mandatory terminating action by October 31, 2001. The remaining Repetitive Inspection ADs were determined to not require additional action.

Task 3 (Improvement of Maintenance Criteria - March 2001)

Recommendation 1: The ATA's Maintenance Program Development Document (that contains the MSG-3 guidelines) is to be updated to reflect the revised definitions of General Visual Inspection and Detailed Inspection. Target: MSG-3 rev. 2001.

Response 1: ATA has updated the MSG-3 document.

Recommendation 2: Training material utilized by regulators, OEMs, operators and 3rd party maintenance organizations to be updated to reflect the revised GVI/DET definitions.

Response 2: The Phase 2 Task 8 will utilize these revised definitions in their recommendation for an enhanced wire systems training program. The FAA will include these recommendations in proposed rulemaking and ACs regarding wire system training. FAA internal training classes under development will utilize these definitions for training for Principal Maintenance Inspectors.

Recommendation 3: Operators shall ensure that they have a dedicated Zonal Inspection section within their approved maintenance program. This may not have been developed for the original MRB report and thus OEM's will be required to assist operators to develop appropriate zonal inspections.

Response 3: The aforementioned proposed SFAR for the EZAP (Task 9.4) will allow operators to incorporate the zonal inspection enhancements. Inclusion of the enhanced zonal inspections will be proposed to be included through Part 121, 125 and 129 rulemaking.

Recommendation 4: OEM's shall apply the enhanced zonal analysis procedure to their in-service products in order to identify additional tasks to better address deterioration of wiring installations. Once developed, operators shall introduce these tasks into their maintenance programs.

Response 4: Refer to Response 3 above. The enhanced zonal inspections developed via performance of an EZAP are proposed to be required for all in-service airplanes, airplanes in production and new certificated designs.

Recommendation 5: STC holders shall update the instructions for continued airworthiness that they provided in support of their design changes. This shall be done through application of the enhanced zonal analysis procedure. Once developed, these shall be introduced in operators maintenance programs.

Response 5: Existing STCs, as with OEM type designs, will be required to update the associated instructions for continued airworthiness to include enhanced zonal inspections through the proposed SFAR and operational rulemaking program. Additionally, it is proposed to update FAR 25.1529, Instructions for continued airworthiness, to require that STC applicants perform an EZAP and provide the data with the STC. Task Groups 6 and 9 are working together to provide recommendation to the FAA on how to implement this change in 25.1529.

Recommendation 6: Where possible, tasks originating from application of the enhanced zonal analysis procedure shall be included in MRB Reports. Where, due to the age of the aircraft, this is not feasible, the recommendations shall be published in a document appropriate to the importance of the issue e.g. Service Bulletin. Whatever method is used to promulgate the additional tasks, the accompanying text shall highlight that the tasks should not be consolidated within the zonal inspections at any time during the aircraft life.

Response 6: The future recommendation associated with Task 9.3 and subsequent proposed operational rulemaking and ACs will meet the intent of this recommendation. Task Group 9 will provide recommendation on implementing an EZAP according to task 9.3 whether it be through the Enhanced Systems Program (MSG-3) or by incorporation of an enhanced zonal inspection program.

Recommendation 7: Should any specific materials be proven to exhibit unacceptable combustion characteristics after removal of an ignition source, FAA should follow-up any necessary actions with the concerned parties.

Response 7:

Recommendation 8: OEM/operator training material (for both aircraft inspection and MSG-3 analysis) and maintenance documentation (as appropriate) should include information on the typical deterioration that is expected to be seen and addressed during accomplishment of a zonal inspection. Chapter 7 [of the

Task 3 Final Report] identifies some items that should be included in addition to the main system components and structural items.

Response 8: The proposed training program that will be contained in the Task 8 (Task 8.3) recommendation will include the expectations of an enhanced zonal inspection program. Additionally, Task 8.4 will contain a recommendation for recurrent SWPM training for procedures that relate to actions resulting from an EZAP.

Recommendation 9: As indicated in Items 1 through 12 in Chapter 8.0 [of the Task 3 Final Report], protections or cautions should be added to the specified locations for each of the maintenance or servicing tasks listed. See 'General Notes' under paragraph 8.3.

Response 9: Task 9.3 requires ATSRAC to consider all aspects of the working group 3 final report, including Chapter 8, Minimization of Contamination. The proposed operational rule and AC will provide the associated guidance (content and format) on how to document necessary protections and cautions to minimize contamination. The recommendation from Task Group 3 did not recommend retroactive application of the action in Recommendation 9.

As related to this recommendation, OEMs have begun including notes in their service bulletins to caution against contamination possibly resulting from the modification.

Recommendation 9: Standards for producing documents listed in the "Locations" section of Item 1 through 12 of Chapter 8 should be updated to ensure appropriate protection and caution information is incorporated in future documents. One example of a standard is ATA Spec 100/iSpec2200.

Response 9: Task 9.3 requires ATSRAC to consider all aspects of the working group 3 final report, including Chapter 8, Minimization of Contamination. The proposed operational rule and AC will provide the associated guidance (content and format) on how to document necessary protections and cautions to minimize contamination.

Recommendation 10: The FAA should be tasked with evaluating current structural anti-corrosion products for long-term affects on wiring. The results should be recommendations for or against the use of specific products on wiring given the high probability that wiring and electrical components will always be subject to some level of contamination by these products. Manufacturers of corrosion inhibiting compounds should be encouraged to adjust their products to minimize detrimental effects on wiring while preserving the highest levels of structural corrosion protection possible.

Response 10: The FAA has included in the Aging Systems R&D program a task to evaluate the effect of anti-corrosion compounds on wire systems. This task is expecting completion in 2003 and is sponsored by Flight Standards.

Recommendation 11: OEMs should be tasked with providing specific guidance for pressure washing to minimize adverse effects on wiring and electrical components (i.e., maximum pressures, minimum nozzle-to-surface distance, maximum cleaning solution pH, maximum temperatures of water, maximum air temperature, and rinse requirements). The results should be in the form of internationally accepted practices.

Response 11: The FAA has included in the Aging Systems R&D program a task to evaluate the effect of pressure washing on wire systems. This task is expecting completion in 2003 and is sponsored by Flight Standards.

Recommendation 12: With respect to Carriage of Livestock and Carriage of Hazardous Materials, OEMs/operators should examine existing documentation to ensure that appropriate and complete instructions are given with respect to cleaning of any spillage that might occur despite the precautions taken. This documentation should emphasize the potential severity of deterioration caused to systems and structure by animal waste products, salt water, caustic chemicals, etc. Guidance should be given on the extent of the cleaning procedures since it is often insufficient to remove only the visible evidence of contamination.

Response 12:

Recommendation 13: FAA to promote/finance the production of a video aimed at convincing senior management within OEMs, Operators and 3rd Party Maintenance Organizations of the need to change the attitude towards wiring. This may use footage already available from the ATA Spec 117 video and should be complemented by pictures actual in-service conditions. Film taken during laboratory testing should not be used. Focus must be on what does occur in service, not theoretical events.

Response 13: One component of the FAA's EAPAS Implementation Plan is labeled as "Outreach." This component is primarily to share the concerns of aging wire systems and the enhancements to mitigate aging. High level FAA officials have presented the EAPAS plan during industry conferences, ICAO general assemblies, operator conferences and with many civil aviation authorities. The intent is to bring about a change in culture regarding wire system maintenance, training and design.

The FAA has also provided via the internet a Wire Systems Job Aid and has made available a training video regarding wire systems. The job aid and training sessions have been given to about 80% of FAA systems and powerplant engineers along with a large percentage of DERs. PMIs are expected to receive similar training. The attitude change called for in this recommendation is being cultivated at high levels of industry and authorities along with those directly responsible for the design and maintenance.

Recommendation 14 The importance of changing maintenance mentality towards electrical wiring installations will require more than simply updating manuals and enhancing training. The need for change must be promoted from above and thus actions must be taken to convince senior management that extended inspection time and improved working procedures are fundamental in achieving an improvement in continuous airworthiness.

Response 14: See response to recommendation 13 to understand the FAA actions towards a new understanding of wire systems. Through the proposed rulemaking and ACs for enhanced inspection requirements and training the FAA will provide a foundation to support this recommendation. However, this recommendation is also focused at changing mentality within OEM, Operator and Repair Station Programs. ATSRAC members have a responsibility to create this change discussed in Recommendation 14 within their own organizations.

Recommendation 15: Update MSG-3 to better address SEDLP [Single Element Dual Load Path] item**s.**

a) Add a new paragraph to the ATA's MSG-3 chapter 3-3, Aircraft Systems / Powerplant Analysis Method to read: *Defining some functional failures may require a detailed understanding of the*

system and its design principles. For example, for system components having single element dual load path features, such as concentric tubes or back to back plates, the function of both paths should be analyzed individually. The degradation and/or failure of one path may not be evident

b) Add an example MSG-3 analysis is to the ATA's MSG-3 guidelines document to address the function of dual load paths in flight controls. This should be introduced when the concept of a 'user's handbook' is developed.

Response 15: This recommendation is focused at industry. However, the FAA is utilizing the recommendations on SEDLP from Task Group 3 Final Report as a basis for new advisory material regarding inspections and maintenance of SEDLP components. Additionally, the FAA is evaluating aging mechanical systems, of which SEDLP components are included, through inspections and destructive tests.

Recommendation 16: Review existing MSG-3 analyses, and/or perform new MSG-3 analysis, on SEDLP components to ensure the dual load path function has been identified and analyzed with new awareness of the design principle.

Response 16: This recommendation is focused at industry. However, the FAA is utilizing the recommendations on SEDLP from Task Group 3 Final Report as a basis for new advisory material regarding inspections and maintenance of SEDLP components. Additionally, the FAA is evaluating aging mechanical systems, of which SEDLP components are included, through inspections and destructive tests.

Task 4 (Review and Update Standard Practices for Wiring - October 2000)

1. There are several reasons why simplification of the Wiring Diagram Manual (WDM) Chapter 20 manuals by users is not recommended:

   a. Would result in different standards from one airline to another.
   b. It would not be practical for the user to do this.
   c. The users need the details for inspection, maintenance and repair that are currently in the manufacturers WDM Chapter 20.
   d. The subject of simplification is addressed in the other recommendations that follow.

   (Not considered as a recommendation)

Recommendation 1: Aircraft and component manufacturers should provide standard practices for care and maintenance of wiring systems. Some examples to be included as a minimum are:

- Cleaning requirements & methods
- Wire & cable identification
- Damage limits by wire/cable type
- Installation limits/requirements dealing with clamping/support, bundle clearances, routing, etc.
- Inspection methods
- Repair/replacement procedures

- Wire & cable replacement alternatives, noting effectivity limits
- General maintenance practices in the aircraft maintenance, structural repair & component manuals to prevent damage to wire & cable during accomplishment of servicing, inspection or repairs
- Types and number of splice repairs including time and location limitations for their replacement

Response 1: This recommendation is being covered in task 8.3 with implementation through a proposed AC on SWMP content and format.

Recommendation 2: Add requirements in ATA 100/i2200 for standard practices for wiring systems. The ATA Working Group should define a structure of major sections for standard practices dealing with wire, cable and other components of the aircraft's electrical system in ATA 100/i2200. These may be included as a new chapter (19) within the aircraft maintenance manual or remain as Chapter 20 within the WDM. The structure should also make provisions for use by component manufacturers and lend itself to the classification of corrective action for reliability reporting by operators. Manufacturers would provide detail and content for the subsections.

Response 2: : This recommendation is being covered in tasks 7.X, 8.3 with implementation through a proposed AC on SWMP content and format.

Recommendation 3: Include in Chapter 20 any standard practices that may be required to support any revised maintenance programs coming out of Task Group 3.

Response 3: Tasks 7.1 requires that a recommendation be developed to fulfill the recommendations from Task 4. Task 7.2 requires that the Task 7 HWG coordinate with Task 9 to ensure consistency between the SWPM and an enhanced maintenance program. Task 8.3 requires that training for the SWPM include standard practices developed under Task 9. Task 9 will utilize the final report from Task Group 3. Implementation of this recommendation will be facilitated by development of an AC on the SWPM. ATA is encouraged to develop a standard that meets the intent of the proposed AC.

Recommendation 4: Assess changes in standard practices for wiring systems which are brought about by recommendations in the final report from the Intrusive Inspections.

Response 4: Task 7 for the SWPM, along with Tasks 6,8, and 9, require that all recommendations resulting from the Phase 2 tasking utilize the recommendations from the intrusive inspection program.

Recommendation 8: Establish the requirement for recurrent qualification training of maintenance technicians to include WDM Chapter 20 content, with particular attention to aging concerns including:

- Safety
- Degradation of wire installations
- Corrosion of components
- Contamination due to chemically active material
- Accumulation of dust, lint, debris
- Damage prevention and cleaning

Response 8: Task 8.4 requires the development of recommendations for recurrent training of the SWPM by maintenance technicians. This training component will be included in the proposed rulemaking and

AC for enhanced wire systems training.

Recommendation 9: Encourage all applicable training programs to highlight prevention as number one and "clean as you go" approaches to reduce potential for compromising nearby wiring installations.

Response 9: The recommendations developed by Task Group 8 will provide a model training program that includes prevention and clean-as-you-go guidance.

Recommendation 10: WDM Chapter 20 standard and supporting documentation including ATA Spec. 117 and applicable FAA circulars should be included as source data to create a training program.

Response 10: Tasks 7,8 and 9 all include as source data ATA Spec 117. The implementation of these tasks will be by proposed operational rulemaking and advisory circulars.

Recommendation 11: Highlight the "human factors" element during training for all disciplines to assure that standard practices are followed.

Response 11: Task 8.4, SWPM Recurrent Training, states that "human factors considerations must be taken into account when developing recurrent training requirements, so that potential for human error will be minimized."

Task 5 (Air Carrier and Repair Station Inspection and Repair Training Programs - March 2001)

Response to Task 5: The training curriculum and lesson plans from Phase 1 ATSRAC recommendations were fairly mature when submitted to the FAA. Task 8 (Phase 2) is required to use the Task 5 recommendations in addition to any changes or new material developed under Task 9. The implementation of Task 8 recommendations will be through proposed operational rulemaking and ACs.

1. The recommended training [described on pages 11-31 of the Task 5 Final Report] is to be used by training providers for all airplane technicians at any stage in their careers. The technician can be trained to the appropriate level using the applicable modules, depending upon the technician's experience, work assignment and the operator's policy. The following eight course modules are defined in detail within the report:

    Module A – Introduction
    Module B – Chapter 20 Structure
    Module C – Inspection
    Module D – Housekeeping
    Module E – Wire
    Module F – Connective Devices
    Module G – Connective Device Repair (OEM specific)
    Module H – Line Replaceable Units (LRU)

2. Because of the level of contamination of airplane wiring systems with dirt and debris, it is recommended that all airplane workers are taught Module D, Housekeeping.

Intrusive Inspection Report (December 2000)

Response to Intrusive Inspection recommendations: All Phase 2 tasks are required to utilize the recommendations from the Intrusive Inspection Report. ATSRAC is managing this effort through the integration function which coordinates all the working group efforts. The FAA also has an internal EAPAS task to ensure that each intrusive inspection recommendation is addressed.

General Recommendation

1. Inspection and maintenance personnel should be made aware of the characteristic degenerative failure modes for specific wire types. Furthermore these personnel should be made aware of the types of wire they are likely to encounter on the aircraft they maintain. Task Group 5 [Training Programs] should implement this recommendation by including appropriate material in their proposed training curricula.

Research Recommendations

2. The FAA should fully support its commitment to its wire degradation assessment project to begin this year. With reference to this report, the degradation assessment project should attempt to explain observed or suspected – but yet unanalyzed – phenomena on the dominant aged wire types. This research should focus on characteristic failure modes and the factors that aggravate or retard degradation.

3. As part of the degradation assessment project the FAA should analyze the effects of wire-to-wire chafing.

4. Also as part of the degradation assessment project the FAA should analyze the effects of common contaminants on wire. Special attention should be paid to corrosion control compounds.

5. Excessive wire heating presents the risk of electrical fire or ignition of surrounding combustible materials. High resistance inter-connections where electrical heating is sufficient to damage the wire insulation are typically detected by visual inspection for embrittled, charred or missing insulation. However, the relationship of observable thermal damage to wire hot enough to hazard the aircraft is still unknown. It is recommended that the FAA conduct research to determine how best to manage this issue.

6. The FAA should aggressively pursue and promote arc-fault circuit breaker development. Many of the recommendations of this report specify this as a potential option to eliminate or mitigate electrical hazards.

7. The FAA should aggressively pursue and promote the development of nondestructive test equipment for aircraft wiring. Many of the recommendations of this report specify this as a potential option to eliminate or mitigate electrical hazards.

8. The intrusive inspection report did not fully consider connector issues. The military and commercial aviation community should sponsor efforts to scope the problem and establish research projects and maintenance guidelines to address the issue.

9. The FAA should investigate the physical and functional integrity of any electrical system component whose failure could hazard the aircraft. This includes: circuit breakers, relays, switches, wire support and bundling systems (including conduit), shielding, ground blocks, etc..

10. The FAA should determine the frequency and significance of non-environmental splices, and assess their potential impact on flight safety. The FAA should also conduct research to assess the significance of unacceptably high resistance connections.

Specific Recommendations (selected items)

11. Aircraft manufacturers should, where appropriate, utilize design practices which facilitate the repair of electrical interconnect systems without the need for splices. Develop splice vs. replacement of wire guidelines.

12. The FAA should revise AC 43-13-1B and other guidance material to stipulate that environmental splices are the preferred method of repairing wire in both SWAMP and non-SWAMP areas. Develop wiring configuration management software that will track the installation and location of splices. Develop best practices regarding the maximum number of splices permitted for various types of circuits based upon frequency and severity of potential splice failures.

13. Aircraft manufacturers should consider updating splicing practice to reflect special considerations associated with:

    a. the proximity of the splice to non-fire-retardant materials
    b. the expected wire current
    c. high-current carrying splices in bundles with wires supporting multiple flight-critical systems

14. Aircraft manufacturers should review design and maintenance practices regarding the use of heat shields. Establish on-condition criteria for the replacement of wire in heat-damaged bundles (external and internal heat).

15. Aircraft manufacturers should review design practices regarding the clamping and tying of wire bundles. Investigate use of non-destructive testing to trouble-shoot suspect wire installations.